

Digital Progressive Area Scan Camera

SVCam

Compact “CP” Line

SVS4021,SVS2020,SVS424,204 and 285

Users Manual

Monochrome / Color Version

Version 1.4



**SVS-VISTEK
GmbH**

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1. Introduction

Thank you for purchasing a SVS-VISTEK product. We hope that you will be satisfied by our service. This camera uses CCD's as optical image sensors. They feature low dark current and high speed readout.

The SVS Compact Line cameras offer full image with one shot, combined with digital output (non interlaced, progressive scan cameras). Further, they feature an excellent S/N ratio at low prices.

The exposure time can be adjusted in different ways. 3 operation modes are available to cover most applications in image processing and optical metrology.

The following types are covered in this manual:

SVS 424 1/3" CCD, 640 x 480 Pixel, 10 Bit gray level resolution, ca 116 frames/sec.
Monochrome and color version.

SVS 204 1/3" ICCD, 1024 x 768 Pixel, 10 Bit gray level resolution, ca 50 frames/sec.
Monochrome and color version.

SVS 285 2/3" CCD, 1360 x 1024 Pixel, 10 Bit gray level resolution, ca 25 frames/sec.
Monochrome and color version.

SVS 2020 14,8 mm diagonal CCD, 1600 x 1200 Pixel, 10 Bit gray level resolution, ca 39.
frames/sec. Monochrome and color version

SVS 4021 21,5 mm diagonal CCD, 2048 x 2048 Pixel, 10 Bit gray level resolution, ca 16.
frames/sec. Monochrome and color version.

12 Bit Version available on request

For more information on the color versions, please see chapter 3.9.

If you need modifications, we will be glad to offer you a custom camera suitable to your application.

Feel free to contact us at:

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2.0 Pinout and Installation

Warning

The CCD camera is built with CMOS-LSI circuits. All internal electronics in the camera are sensitive to high voltage or electrostatic discharge. The camera can be destroyed if carelessly handled, so extreme care should be taken during set up and operation.

Do not expose the sensor to a direct laser beam as this could damage the sensor! **See Safety Instructions at Appendix E. Warranty will be void if not followed.**

2.1 Unpacking

- Camera
- Power supply (if ordered/option)
- User Manual
- Disk with "Convenient Cam" program

2.2 Power supply

Male connector (Type TB3M Microswitch)

PIN 1	+12V to +15 V DC
PIN 2	Reserved (Do not connect)
PIN 3	GND

Current consumption:

SVS4021 and SVS2020 (only) = 600 mA (typical)

Peak current on "Power on" up to 2 Ampere !
Current consumption increases rapidly when "partial scan" feature is used !

All other models : 450 mA

2.3 Trigger connector

TB 5M connector, 5 pin, is used to give an external TTL-trigger-input (galvanic decoupled) to the camera , if it is not done per frame grabber.

TTL Exsync input to trigger camera (optocoupler input)

Pin 4 : Tr - (Exsync GND)

Pin 5 : Tr + (Exsync TTL)

See outline in chapter 3.4

See chapter 2.6 Available operation modes

2.4 “Camera Link” Connector

26 Pin connector MDR female (3 M): Base configuration with RS 232 communication

Pin	Name	Direction	Meaning
1	GND		
2	X 0-	Camera=>FG	Data
3	X 1-	Camera=>FG	Data
4	X 2-	Camera=>FG	Data
5	Xclk-	Camera=>FG	Transmitterclock/PVAL
6	X3-	Camera=>FG	Data
7	Ser TC+	FG => Camera	Camera control (RS232)
8	SerTFG-	Camera=>FG	Camera control (RS232)
9	CC1-	FG => Camera	Exsync
10	CC2+	FG => Camera	Prin (not used)
11	CC3-	FG => Camera	External camera clock
12	CC4+	FG => Camera	NC
13	GND		
14	GND		
15	X 0+	Camera=>FG	Data
16	X 1+	Camera=>FG	Data
17	X2+	Camera=>FG	Data
18	Xclk+	Camera=>FG	Transmitterclock/PVAL
19	X3+	Camera=>FG	Data
20	SerTC-	FG => Camera	Camera control (RS232)
21	SerTFG+	Camera=>FG	Camera control (RS232)
22	CC1+	FG => Camera	Exsync
23	CC2-	FG => Camera	Prin (not used)
24	CC3+	FG => Camera	External camera clock
25	CC4-	FG => Camera	NC
26	GND		

Camera has a “BASE” configuration according to Camera Link definition. However, the output of the Kodak 2020 and 4021 CCD is a two tap sensor compared to cameras using Sony CCD,

2.5 Installation

1) Install camera in the desired location. You can use the ¼ " tripod adapter or use the 4 M3 holes in the adapter of the camera.

2) Connect the power supply . If you have ordered a P/S connect it to the 3 Pin connector on the camera. If you use your own power supply (must be 12 V DC) make sure you connect it to Pin1 (+12 V) and Pin 3 (GND). **If you – by mistake- supply line with GND pin the camera can be damaged !** If power supply was ordered, do not modify it.

Connect a Camera Link cable to your frame grabber. Please note that cable length should not exceed 10 m for these camera ("F" version). A **REPEATER** is available to extend cable length. Consult your local distributor!

2.6 Available Modes of Operation

General:

All modes are set by the serial interface which connects via Camera Link standard cable . The default factory setting is **Freerunning** using the internal microcontroller for exposure control : Mode 0. The Gain of the signal can be adjusted software wise by a factor of 2 . Please note that noise also is amplified. **Higher Gain is possible but not specified !** The Gain default setting is 1.0.

Mode 0: Freerunning using Microcontroller

In this mode the camera creates all sync signals itself. The frame rate is ca. 16 and there is no need to trigger the camera (by EXSYNC) in order to get data. **The Exposure time can be set by using the serial Interface of the PC.** The enclosed program allows the user to set the values from about 10.000 /Sec (1 line duration) to one frame duration. Exposure time can be changed online during operation.

Mode 1: Triggered and using Pulse width of Exsync

In this mode the camera is waiting for an external trigger which causes the integration and read out. The exposure time can be varied by the length of EXSYNC between the high going edge and the low going edge. The Time settings in the control menu are not activated. This mode is useful in applications where the light level of the scene changes during operation. A frame to frame variation is allowed. Trigger can be fed via Framegrabber (if supported) or by TTL into on TB 5 connector **(see 2.3)**

Mode 2: Triggered and using Microcontroller

The frame rate is determined by the number of Exsync pulses per time. With each positive transition (going high) the camera will readout a frame. The Exposure time is set as mentioned in Mode 0. The maximum exposure time is 65535 line durations, Minimum is 1 line duration. Trigger can be fed via Frame grabber (if supported) or by TTL into on TB 5 connector **(see 2.3)** Exposure time can be changed online during operation.

Software:

The camera comes with "**Convenient Cam**" program allowing interactive access to above parameters. This software is available for WIN XP and WIN 2000 .

The color version will come on request with free software algorithm which will allow processing of the color image in the PC. This must to be done in order to interpolate the colors for each pixel. Please note that no responsibility can be taken for the algorithm. It might be necessary to change the algorithm according to the application. **See chapter 3.7 .**

3.0 Operation

An easy logic allows control of the camera by different signals to achieve optimum image quality.

3.1 Sensors :

- Sony: ICX 424, ICX204, ICX285
- Kodak KAI 2020M/C 1600 x 1200 Pixel
- Kodak KAI 4021M/C 2048 x 2048 Pixel

Note following cosmetic specs for Kodak CCD:

Cluster allowed. Cluster may contain up to 10 pixel out of PRNU spec.

8 cluster allowed

Point defects: 10 dead pixel allowed.

More details are available in the KAI 2020AND 4021 spec sheet.

Spectral range: 400 - 900 nm(B/W), COLOR version: RGB Bayer Mosaic Filter, **see 3.7**

3.1.2

Readout from CCD/SVS2020 and 4021 only

The output for the “U “ and “F” version is as follows:

2 taps are read out and the right half of the image is mirrored starting at 1st line pixel #1025 through 2048 (4021). See image below. As a result either framegrabber or PC memory must reverse the 2nd half in order to get a complete image as it is for the “S” version.

There the complete image is read out as usual with one tap CCD.



2 Tap output “F” and “U” version



1 Tap output “S” version

3.2 Signal conditioning

The analog output of the sensor is conditioned by Correlated Double Sampling (CDS) for optimum S/N ratio. Dark level drift is compensated by an “auto zero” amplifier circuit and fed into a video ADC with 10 bit resolution.

3.3 Interfacing/ use of the “ convenient cam ” program

The camera can be operated in a free running mode as well as in a synchronized and triggered mode. An exposure control can be set by serial communication or by using the pulse width of the trigger signal (Exsync).

For PC support a software disk, “Convenient Cam ”, is enclosed which allows setting of parameters via a serial port. For OEMs the source code is available on request. A DLL is delivered with the program and is required to get the “Convenient Cam ” program working.

See screen shot of the menu at the end of this section!

The camera can also be operated with any terminal program. **See “Command Overview.doc”** If you have installed the camera and connected power, you can install the program to do the first test. Copy the **ConvCam.exe and the DLL** to your disk drive, double click on the Convenient Cam icon and a window will open. **The program will fail to start if it can't find the DLL! Check the Readme file and Load DLL in ConvCam menu.**

If you get error messages starting the software make sure that your camera is connected to the chosen port (usually com 3,4,5,6,due to Camera Link standard).

You can change the port with the **“COM:”-field if the Camera Link will not work immediately.**

The **“ read status”** button will cause the camera to respond and give the following information:

The type of sensor at **INFO** series number and at **Mode** operation mode will be displayed.

The “Mode” field

Free Running, Mode 0

At the first installation it should be mode 0 (factory default). This means the camera is free running with maximum frame rate and exposure time is controlled by the internal micro controller. Exposure time can be set via serial communication (ConvCam2.exe, see “Exposure time”-field below). No further external signals.

Triggered, external exposure control, Mode 1

If you want to trigger the camera and determine the exposure time by the pulse width of Exsync, choose mode 1.

Then apply a Exsync signal at the appropriate pins e.g. on pins of TB 5 connector or via Camera Link through you frame grabber. (Contact your frame grabber supplier for how to feed signal into the grabber). (See “Trigger”-buttons below). With the rising edge of the pulse the camera will start exposure time. The exposure time ends with the falling edge of Exsync.

Please check the timing diagram in the appendix of this manual.

Triggered, internal exposure control, Mode 2

If you want to trigger the camera and use the convenient exposure time control of the micro controller then use mode 2. You still can use the serial port for setting exposure time (see “Exposure time”-field below). However you need to use the Exsync signal in order to trigger the camera (see “Trigger”-buttons below).

The “Binning” field: readout modes

You can choose different resolutions

No Binning: Full resolution: horizontal x 1, vertical x 1 (default setting)

H2x V2x: Vertical 2x and Horizontal 2x at the same time:

Resolution: horizontal x ½, vertical x ½,

Sensitivity is 4x, pixel frequency is halved, max. frame rate is almost doubled.

“No Binning” sets the camera to full resolution

If you need other binning mode configurations consult factory or your nearest distributor. **Using binning with a color version of the camera will cause incorrect colors and strange effects !!** However, for fast focusing it might be useful.

Note that you probably have to change camera file of your frame grabber if you change operation mode !

The Partial Scan field:

Partial scan of lines can be chosen in steps of 16 lines (19 lines SVS4021). As an example for SVS4021: The minimum number and starting point are 17 lines. The max. number is 2031. As a result the frame rate of the camera will be increased when resolution is lower. e.g. 2048 x 1024 yields 29 fps. Partial scan is done starting in center of the imager.

If you need other readout mode configurations consult the factory or your nearest distributor.

Note that you probably have to change camera file of your frame grabber if you change resolution !

The “Options” field**The “Trigger” functions**

Here you can determine if you want to use the differential **LVDS** trigger via frame grabber and the CAMERA LINK cable or if you would rather use the **TTL (min 5 V)** trigger on the TB 5 connector on the Camera. The latter is sometimes easier if a TTL signal is provided from encoder, flashlight or any other source.

“internal clock”

Default clock source. On board camera clock can be configured with full speed/ reduced speed option.

“Load camera DLL”

Depending on the type of frame grabber it is sometimes necessary to get the ConvCam program working only if the DLL is activated. For this purpose simply click on this option if you don't get communication with the camera.

“Reduced speed”/“Full speed

Here you can lower the clk speed and as result the frame rate: If you tick reduced speed the frame rate is only about half than the initial one. **This is only intended to be used if PCI bus load for the framegrabber must be reduced.**

The “camera “folder

The ”Exposure time “ field

Exposure time: the exposure time can be set in μsec . The min exposure time is about 50 μsec (depending on the camera type and speed). The longest is about several seconds (triggered modes). Due to the internal timing of the camera the program will adjust the values to the appropriate values. Exposure time can also be expressed as “line time” because the minimum time set is the duration of one line. If you use this field the exposure time in μsec will change automatically and vice versa.

The “Gain” and “Offset“ field

The default gain setting is “1.0”. You may change the gain up to factor 2.0 (or higher) in steps of $1/10^{\text{th}}$. Note that the dark offset will increase and dynamic range will not be improved! For good image quality do not increase gain more than factor 2, because the noise is also amplified. “Gain value” allows finer adjustments than “gain factor”.

“U” and “F” version of SVS 2020 and 4021 only :

Note that the CCD has 2 outputs. Therefore there are a “right” and a “left” image half. If you use the slider both channels are amplified. However depending on the amplifications there might be different values necessary in order to make both channels equal. Fine tuning in “Gain Value” is necessary. There are about 768 possible steps to adjust. It is still possible to have 1-2 counts difference between both image halves. This is NOT a camera problem and must be adjusted by an experienced user. Same is true for the offset.

Dark level offset adjustment is possible. Please note that factory adjustment is optimized for S/N ratio and sensitivity. You may lose dynamic range. Alter only if you operate at high temperatures like +40 °C. It can be altered for each channel separately.

The “Save to EEPROM” button

If you have configured your camera successfully you can save the actual configuration in the EEPROM of the micro controller. Every time the camera is connected to power it will start with this configuration. Ensure that your camera is running correctly before you click this button!

The “Reset Camera” button

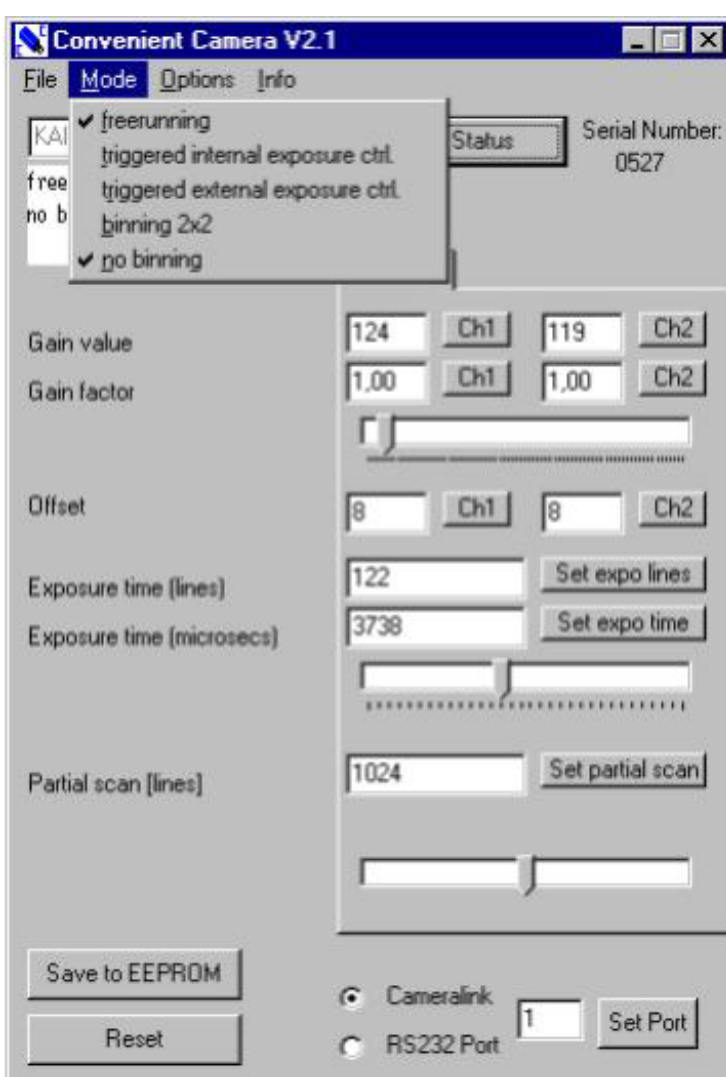
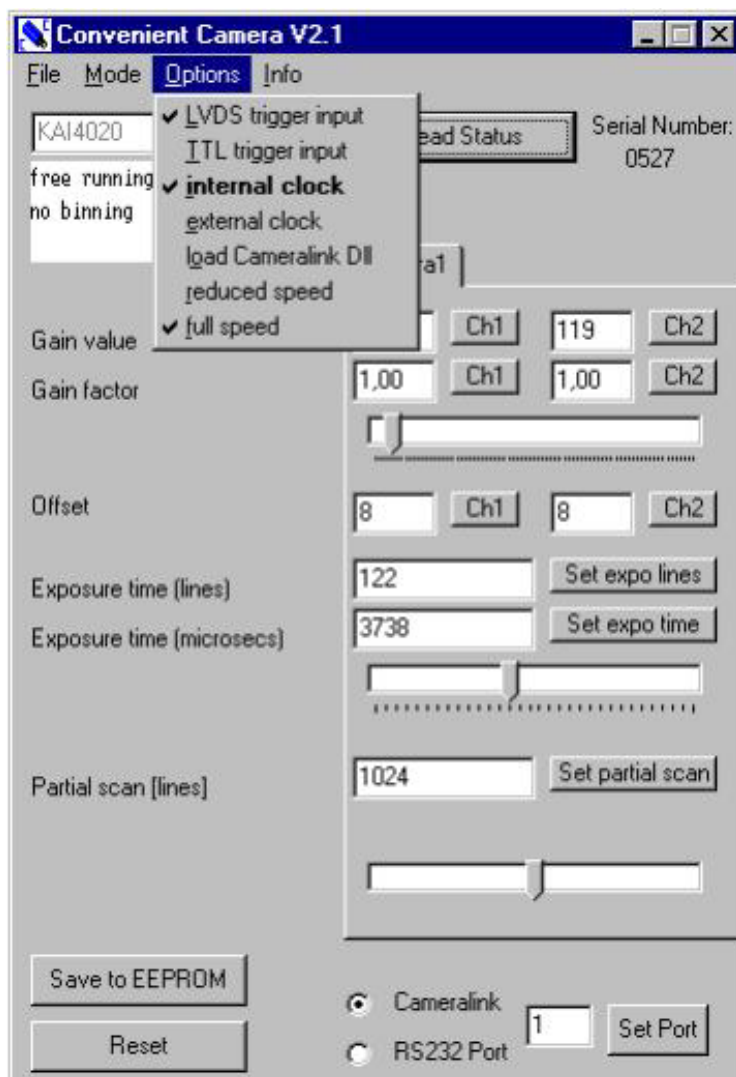
If you have troubles during configuration, you can set the last saved configuration clicking this button (you could also switch power off and on and also and click on “read status” again).

The “ COM Port”:

Set COM port for serial control which will work with your frame grabber via Camera Link.

The “RS232 and Camera Link” Box

Set always to “Camera Link” for communication via Frame grabber. **If you set to “RS232 Port”, communication via Frame grabber will usually NOT work ! It is intended for LVDS type of cameras.** (Classing Line, big housing).

Screen shots of “Convenient Camera” menu

3.4 Mechanical and optical issues

SVS4021 and SVS2020 (ONLY)

Camera size: 50 x 55 x 43mm (without connectors and lens)

Weight: Appr. 200 Gram

Front plate with M 42 x 1 threads and C mount adapter. SVS2020 with C-Mount

Distance from Chip surface to frontplate: 11,65 mm

NOTE: THE C-MOUNT ADAPTER of SVS4021 IS INTENDED FOR EASY SETUP. However it might cause dark edges due to a loss of light in the corners. This is known and not a fault of the camera.

We recommend use of solutions from Schneider, SILL or LINOS(Rodenstock) who offer interfaces to M42 thread. Sometime C-Mounts work with focal length longer than 50 mm. Do not use lenses which are intended for CCDs smaller than 1 “!!!

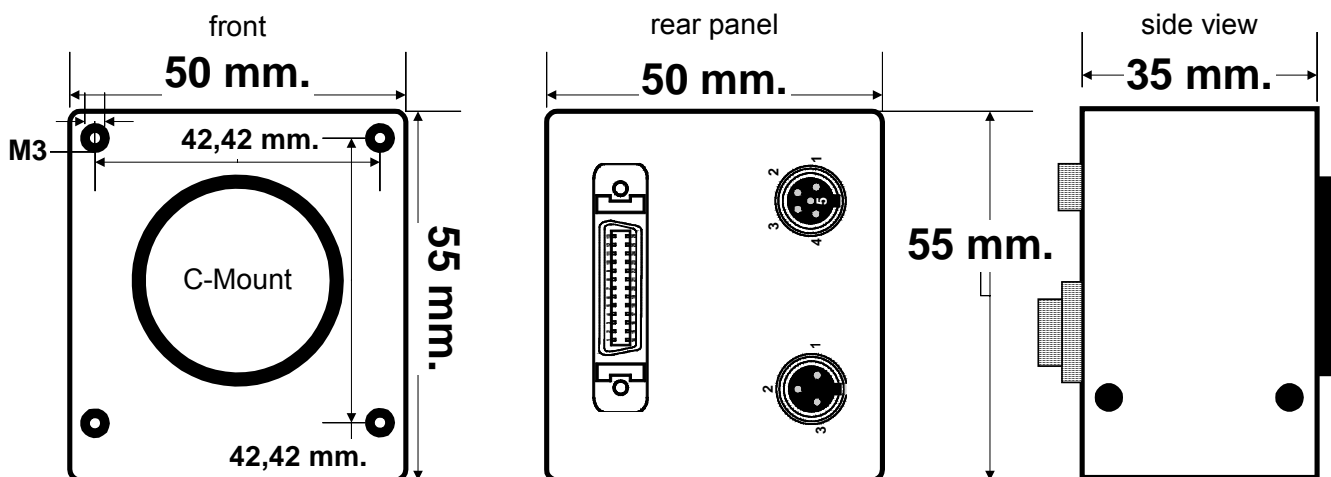
SVS424, 204 and 285

Camera size: 50 x 55 x 35mm (without connectors and lens)

Weight: Appr. 200 Gram

Front plate with C mount adapter.

Views on Camera :



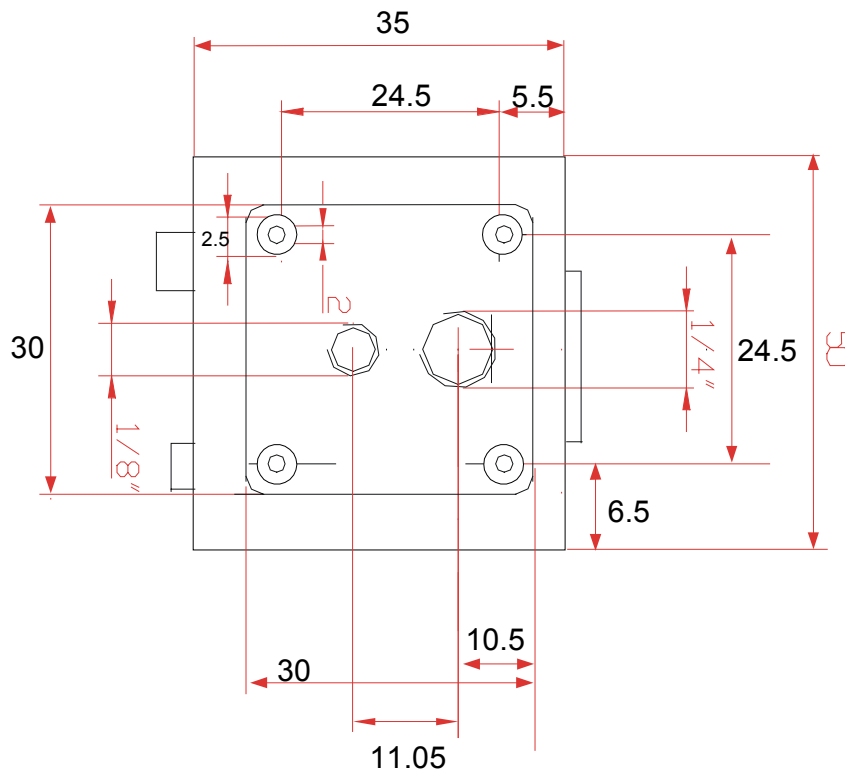
MDR 26 female Connector
Sync and Dataserial LVDS
see Listing on 2.4..2
Mating connector:
3M

Part.-Nr of connector 10126-6000EL

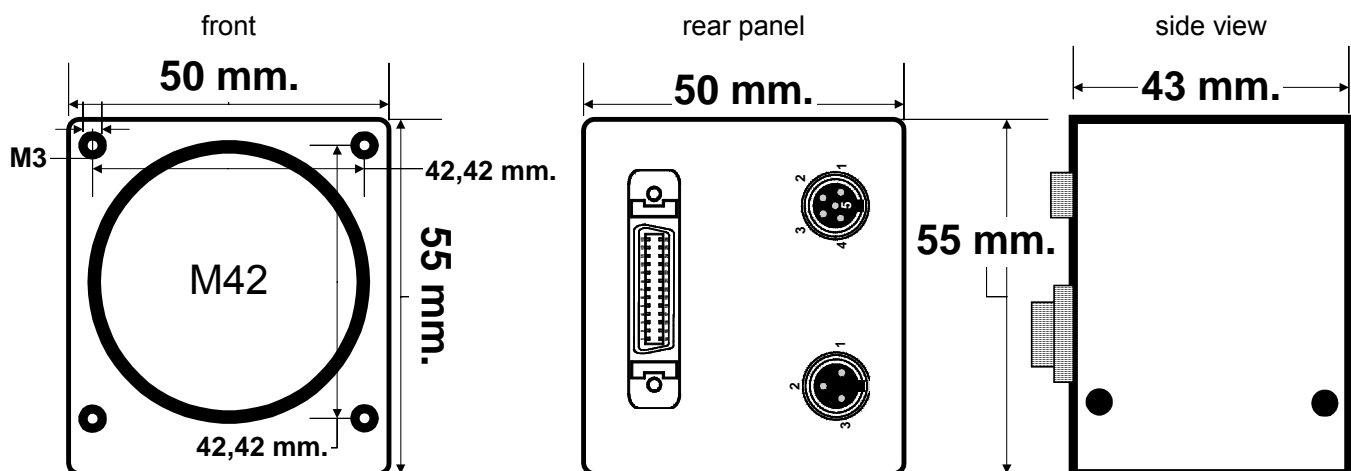
Part .-Nr of hood: 10326-A200-00

Power Connector:
Pin 1: +12V
Pin 3: GND
Pin 2: Reserved
Mating connector :Switchcraft TA3F

Trigger Connector:
Pin 4: TTL -(GND)
Pin 5: TTL +
Pin 1,2,3 : Do Not Connect
Mating connector :Switchcraft TA 5F

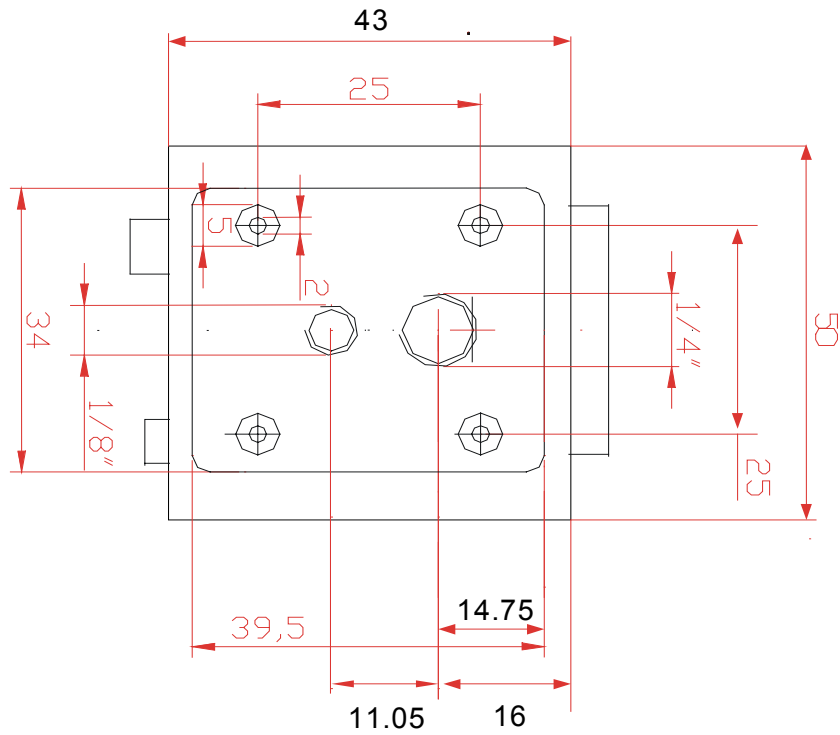
View on mounting side SVS424/204/285**Views on SVS2020 and 4021 except front (C-Mount)**

Distance from Chip surface to frontplate: 11,65 mm



M42 x 1 to C-mount adapter is a standard when SVS4021 is delivered

View on mounting side SVS2020 and 4021



3.5 Basic electro-optic specifications of camera SVS424

CCD ICX 424 1/3" Interline	480 x 640 Pixel	Pixelsize 7,4 x 7,4 μm
Readout frequency	1 x 48 MHz	
Framerate (max)	116 FPS	
Framerate (2 x 2 Binning)	336 FPS	
OFFSET	Ca. 10 counts	
Gain	1 to 2	
S/N ratio	8,5 Bit (Saturation/Dark Noise(RMS)	
Fixed Pattern Noise	+/- 2 counts	
Photo Response Nonuniformity (PRNU)	+/- 10 %	
Spectral response	380 –950 nm	
Exposure time (mode 2)	50 μSec – 2 Sec	
Leading dark lines	1	

Basic electro-optic specifications of camera SVS204

CCD ICX 204 1/3" Interline	1024 x 768 Pixel	Pixelsize 4,65 x 4,65 μm
Readout frequency	1 x 48 MHz	
Framerate (max)	50 FPS	
Framerate (2 x 2 Binning)	150 FPS	
OFFSET	Ca. 10 counts	
Gain	1 to 2	
S/N ratio	8 Bit (Saturation/Dark Noise(RMS)	
Fixed Pattern Noise	+/- 2 counts	
Photo Response Nonuniformity (PRNU)	+/- 10 %	
Spectral response	380 –950 nm	monochrome
Exposure time (mode 2)	50 μSec –2 Sec	
Leading dark lines	1	

Basic electro-optic specifications of camera SVS285

CCD ICX 285 2/3" Interline	1360 x 1024 Pixel	Pixelsize 6,54 x 6,54 µm
Readout frequency	1 x 48 MHz	
Framerate (max)	25 FPS	
Framerate (2 x 2 Binning)	62 FPS	
OFFSET	Ca. 10 counts	
Gain	1 to 2	
S/N ratio	8,5 Bit (Saturation/Dark Noise(RMS)	
Fixed Pattern Noise	+/- 2 counts	
Photo Response Nonuniformity (PRNU)	+/- 10 %	
Spectral response	380 –950 nm	
Exposure time (mode 2)	50µSec – 2 Sec	
Leading dark lines	1	

Basic electro-optic specifications SVS2020 “S” version

CCD KAI 2020 1 1/4" Interline	1600 x 1200 Pixel	Pixelsize 7,4 x 7,4 µm
Readout frequency	1 x 40 MHz (1 tap)	
Framerate (max)	18.5 FPS	
OFFSET	Ca. 10 counts	
Gain	1 to 2	
S/N ratio	9 Bit (Saturation/Dark Noise(RMS) Color version 8 Bit	
Fixed Pattern Noise	+/- 2 counts	
Photo Response Nonuniformity (PRNU)	+/- 10 %	
Spectral response	380 –950 nm	
Exposure time (mode 2)	60µSec – 4,7 Sec	
Leading dark lines	2	

Basic electro-optic specifications SVS2020 “F” version

CCD KAI 2020 1 1/4” Interline	1600 x 1200 Pixel	Pixelsize 7,4 x 7,4 µm
Readout frequency	2 x 40 MHz (2 taps)	
Framerate (max)	30 FPS	
OFFSET	Ca. 10 counts	
Gain	1 to 2	
S/N ratio	9 Bit (Saturation/Dark Noise(RMS) Color version 8 Bit	
Fixed Pattern Noise	+/- 2 counts	
Photo Response Nonuniformity (PRNU)	+/- 10 %	
Spectral response	380 –950 nm	
Exposure time (mode 2)	75µSec – 1,6 Sec	
Leading dark lines	2	

Basic electro-optic specifications SVS2020 “U” version

CCD KAI 2020 1 1/4” Interline	1600 x 1200 Pixel	Pixelsize 7,4 x 7,4 µm
Readout frequency	2 x 50 MHz (2 taps)	
Framerate (max)	40 FPS	
OFFSET	Ca. 10 counts	
Gain	1 to 2	
S/N ratio	8 Bit (Saturation/Dark Noise(RMS) Color version 8 Bit	
Fixed Pattern Noise	+/- 2 counts	
Photo Response Nonuniformity (PRNU)	+/- 10 %	
Spectral response	380 –950 nm	
Exposure time (mode 2)	50µSec – 1,3 Sec	
Leading dark lines	2	

Basic specifications of camera SVS4021 “S” version

CCD KAI 4021 1” Interline	2048 x 2048 Pixel	Pixelsize 7,4 x 7,4 µm
Readout frequency	1 x 40 MHz (1 tap)	
Framerate (max)	8 FPS	
OFFSET	Ca. 10 counts	
Gain	1 to 2	
S/N ratio	9 Bit (Saturation/Dark Noise(RMS) Color version 8 Bit	
Fixed Pattern Noise	+/- 2 counts	
Photo Response Nonuniformity (PRNU)	+/- 10 %	
Spectral response	380 –950 nm	
Exposure time (mode 2)	120µSec – 9,4 Sec	
Leading dark lines	11	

Basic electro-optic specifications SVS4021 “F” version

CCD KAI 4021 1 1/4” Interline	2048 x 2048 Pixel	Pixelsize 7,4 x 7,4 µm
Readout frequency	2 x 40 MHz (2 taps)	
Framerate (max)	16 FPS	
OFFSET	Ca. 10 counts	
Gain	1 to 2	
S/N ratio	9 Bit (Saturation/Dark Noise(RMS) Color version 8 Bit	
Fixed Pattern Noise	+/- 2 counts	
Photo Response Nonuniformity (PRNU)	+/- 10 %	
Spectral response	380 –950 nm	
Exposure time (mode 2)	60µSec – 4,7 Sec	
Leading dark lines	11	

Basic electro-optic specifications SVS4021 “U” version

CCD KAI 4021 1 1/4” Interline	2048 x 2048 Pixel	Pixelsize 7,4 x 7,4 µm
Readout frequency	2 x 48 MHz (2 taps)	
Framerate (max)	20 FPS	
OFFSET	Ca. 10 counts	
Gain	1 to 2	
S/N ratio	8 Bit (Saturation/Dark Noise(RMS) Color version 8 Bit	
Fixed Pattern Noise	+/- 2 counts	
Photo Response Nonuniformity (PRNU)	+/- 10 %	
Spectral response	380 –950 nm	
Exposure time (mode 2)	50µSec – 1 Sec	
Leading dark lines	11	

3.6 Enviromental Testing:

The camera is CE tested and the rules of EN 50081-2 apply.
Camera complies with FCC Form 740 Rules.

It is necessary to use a shielded power supply cable which has GND contact to the camera housing. This is essential for any use. If not done and camera is destroyed due to Radio magnetic Interference (RMI) WARRANTY is void !

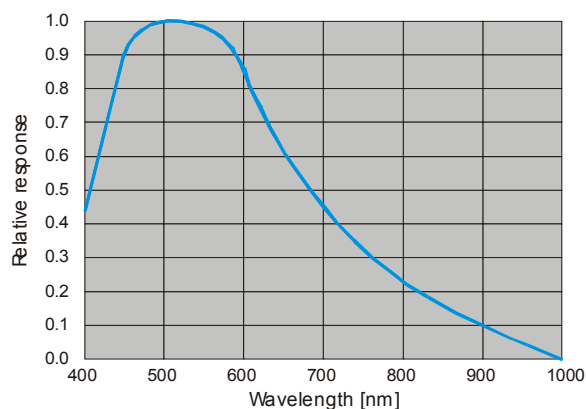
Operating temperature Spec: -10 - +40°C. In order to keep dark current low.
To achieve 9 optical Bits, operation at 25° max.
is recommended.

Shock is tested about 30 g in 6 ms. Vibration test is 10 g in 6 ms

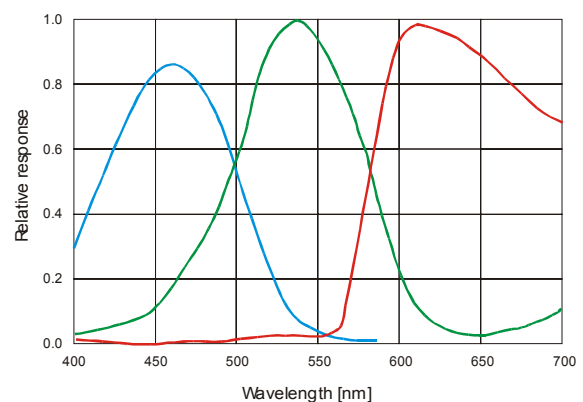
Power: US/UK and European line adapter can be delivered. Otherwise
use +12V DC with filtered and stabilized power supply.

3.7 Spectral response curves

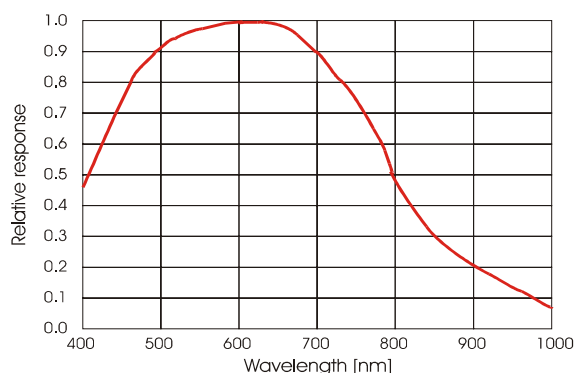
Monochrome Version SVS4021/2020/424and 204



All Color Version



SVS285 monochrome



3.7. Comments on camera temperature

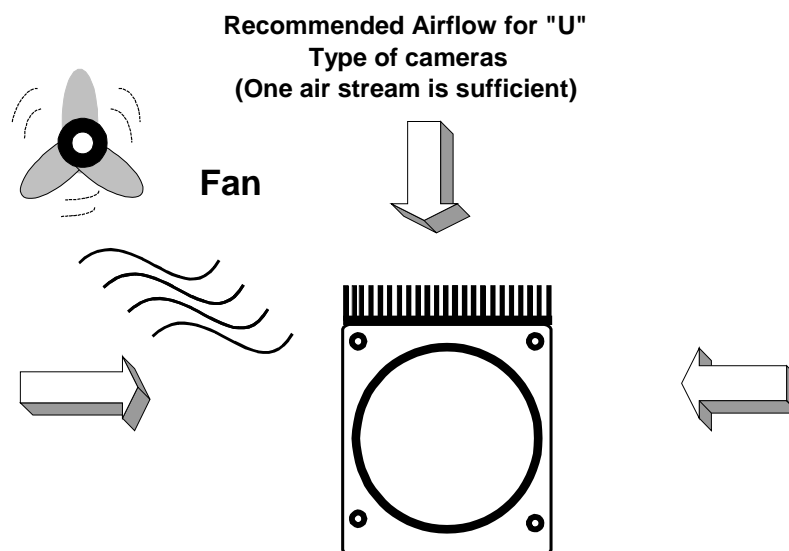
Higher case temperature is noticed for SVS4020 and SVS4021 version.

There is no need to worry because camera has been tested at higher temperature than specified (40 °C). However some components inside like CCD, ADC, drivers are pushed to their limits.

In order to take advantage of the speed of the “U” (Ultra High Speed” version) it must be operated with forced air cooling. It means a gentle airflow not causing vibrations ! This will help to extend life time of the camera

Note that Warranty will be void if you don't follow these instruction for “U” version !

Recommended setup:



05.07.05

3.8 Comments on COLOR Version

If you have purchased a COLOR version of this camera, please note the following:

In all electrical terms the camera is identical to the black and white versions. The output is parallel or Camera Link but the color pixels are transferred in series from the camera.

The camera uses a CCD which has a color mosaic filter. This filter is called "Bayer" filter named after the person who invented it. It has a pattern on the lines which alternates as follows:

E.g.:First line: RGRGRG.... and so on. (R=RED, B=BLUE, G=GREEN)
Second line: GBGBGB.... and so on.

Please note that about half of the pixels are green, a quarter red and a quarter blue. This is due to the maximum sensitivity of the human eye at about 550 nm (green).

Because this camera is a single chip camera it is necessary to use an algorithm which interpolates those colors which are " not known" by the specific pixel. E.g. The red pixel does not know its green and blue components.

This means that the performance of the image depends on the software used.

Please be aware that it is not possible to incorporate the algorithm into the camera so easily. Unlike NTSC/PAL cameras there is no hardware chip available which can do that for such large images. The user has the advantage to alter the colors depending on his needs. Thus the color image must be processed in the PC. A color source code is available on request.

We offer a complete set for a system setup containing camera, cable, power supply, frame grabber and software to help solving your applications.

If you have questions do not hesitate to contact us or your local dealer.

4.0 Proven Interfacing to Frame grabbers

These Frame grabbers have been adapted to cameras mentioned in this manual successfully:

<i>EURESYS :</i>	Grablink Value/Expert
<i>CORECO :</i>	PC-CamLink X64 CameraLink/ X64 I-PRO
<i>Matrox:</i>	Meteor II Helios
<i>Matrix Vision :</i>	Titan CL
<i>Active Silica :</i>	Phoenix
<i>Silicon Software :</i>	Micro Enable III

Please check individual camera types with framegrabber manufacturer !

4.1. Warranty Terms

Standard products warranty and adjustment. Seller warrants that the article to be delivered under this order will be free from defects in material and workmanship under normal use and service for a period of **TWO** years from date of shipment. The liability of Seller under this warranty is limited solely to replacing or repairing or issuing credit (at the discretion of Seller) for such products that become defective during the warranty period. In order to permit Seller to properly administer this warranty, Buyer shall notify Seller promptly in writing of any claims,; provide Seller with an opportunity to inspect and test the products claimed to be defective. Such inspection may be on customer's premises or Seller may request return of such products at customer's expense. Such expense will subsequently be reimbursed to customer if the product is found to be defective and Buyer shall not return any product without prior return authorization from Seller. If a returned product is found to be out of warranty or found to be within the applicable specification, Buyer will have to pay an evaluation and handling charge, independent of possible repair and/or replacement costs. Seller will notify Buyer of the amount of said evaluation and handling charges at the time the return authorization is issued. Seller will inform Buyer of related repair and/or replacement costs and request authorization before incurring such costs. Buyer shall identify all returned material with Seller's invoice number, under which material has been received. If more than one invoice applies, material has to be clearly segregated and identified by applicable invoice numbers. Adjustment is contingent upon Seller's examination of product, disclosing that apparent defects have not been caused by misuse, abuse, improper installation of application, repair, alteration, accident or negligence in use, storage, transportation or handling. In no event shall Seller be liable to Buyer for loss of profits, loss of use, or damages of any kind based upon a claim for breach of warranty.

Development Product Warranty. Developmental products of Seller are warranted to be free from defects in materials and workmanship and to meet the applicable preliminary specification only at the time of receipt by Buyer and for no longer period of time in all other respects the warranties made above apply to development products.

The aforementioned provisions do not extend the original warranty period of any article which has been repaired or replaced by Seller. If Warranty Label of camera is broken Warranty is void!

SELLER MAKES NO OTHER WARRANTIES; EXPRESS OR IMPLIED; AND SPECIFICALLY; SELLER MAKES NO WARRANTY OF MERCHANTABILITY OF FITNESS FOR PARTICULAR PURPOSE.

Appendix A - Troubleshooting

Problem: Camera does not respond to light

Solution: Please execute following steps

Check if camera is in mode 0). Thus: Freerunning with serial exposure ctrl . When done, check with "Convenient Cam" program if you can read back any data from the camera like : Mode, type of CCD, exposure time settings and so on.

If Mode 0) works check the signals of the camera in the desired operation mode like 1) or 2). In these modes check if the Exsync signal is present. Please note that a differential signal must be fed to the SCSI 4 connector . The typical signal swing for LVDS must be about 250 mV. Below such level the drivers in the camera will not work. If you use a TTL level signal fed to the TB 5 connector check the quality and swing. If these signals are not there or don't have the right quality the camera can not read out any frame (mode 1 and 2).

Problem: Image is present but distorted:

Solution: Check the camera configuration file of your framegrabber. Check number of "front- and back porch " pixel. Wrong numbers in configuration file can cause sync problems. Check if your framegrabber can work with the data rate of the camera.

Problem: The image of a color version camera looks "ugly" or false colors appear.

Solution: If the raw image looks OK check the camera file to see if the pixels need to be shifted by either one pixel or one line. The image depends on the algorithm used. If the algorithm is starting with the wrong pixel such effects appear.

Problem: The colors of a color version are not perfect especially when using a halogen light.

Solution: Halogen light contains strong portions of IR radiation. Use cut off filters at around 730 nm like Schott KG 3 to prevent IR radiation reaching the CCD.

Problem: No serial communication is possible between the camera and the PC Camera Link)

Solution: Use "load camera DLL" and try again.



TROUBLESHOOTING REQUEST LIST V1.1

Dear valued customer,

In order to help you with your camera and any interfacing problems we request that you fill in a description of your problems when you use the camera. Please fax this form to us:

- 1) Type of camera (e.g. SVS4021XXCP)
- 2) Serial Number
- 3) Accessories used and where purchased or self made
 - a) Power supply
 - b) Cable
 - c) Lens type and focal length
- 4) Firmware version as well as operation mode, (send screenshot of ConvCam program)
- 5) Description of the phenomena, e.g.:
 - a) missing lines or columns
 - b) distorted or noisy image (if possible send jpg image)
 - c) solarization effect
 - d) missing bits, contrast less image
- 6) Framegrabber used. Brand and type
- 7) IN CASE OF EURESYS and CORECO FRAME GRABBER ONLY:
 - a) Driver version used. If Patch: Please specify
 - b) Camera file used
 - c) Operating system used e.g. WIN98/NT/2000/XP

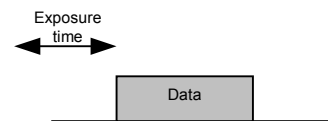
Appendix B - Basic timing for different operation modes

Notes.:

The fundamental signals are PVAL (STROBE), LVAL and FVAL, and in case of triggered modes, Exsync .

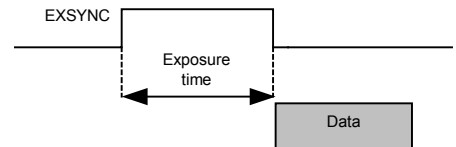
Mode 0 : Free running using serial Interface

A frame is readout automatically and the data are valid indicated by LVAL per line and FVAL by frame. The data is valid at the rising edge of PVAL (Strobe) The frame rate is about 13 FPS and there is no need to trigger the camera in order to get data. The enclosed software allows the user to set exposure time e.g. from 60 μ sec 60 mSec (camera type dependent). The time set stays resident after power off if the configuration is saved to EEPROM.



Mode 1: External Trigger and Pulsewidth of EXSYNC

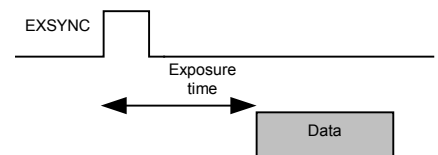
In this mode the camera is waiting for an external trigger which starts integration and read out. Exposure time can be varied using the length of the EXSYNC pulse (I. E. between the high going edge and the low going edge). The time settings in the control software are not activated. This mode is useful in applications where the light level of the scene changes during operation and the framegrabber can provide such a signal. Change of exposure time is possible from one frame to the next.



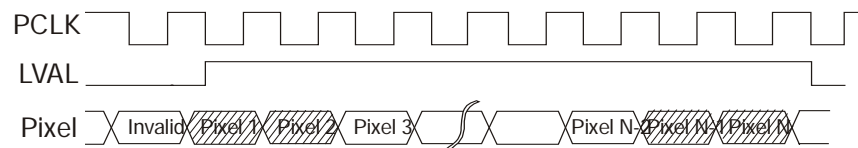
Mode 2 : External trigger and serial Interface

The frame rate is determined by the number of EXSYNC pulses per time unit. With each positive transition (going high) the camera will readout a frame. Exposuretime is set in the same way as in the free running mode but with an exposure range from 60 μ Sec to 4,3 Sec.

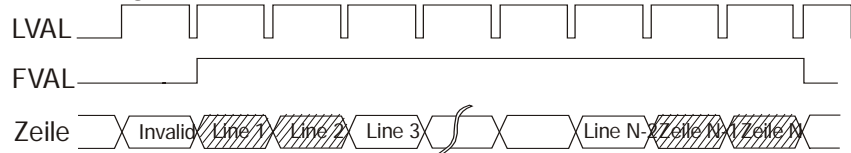
Exposure time can be changed online during operation. No frame is distorted during switching time. The time set stays resident after power off, if the configuration is saved to EEPROM.



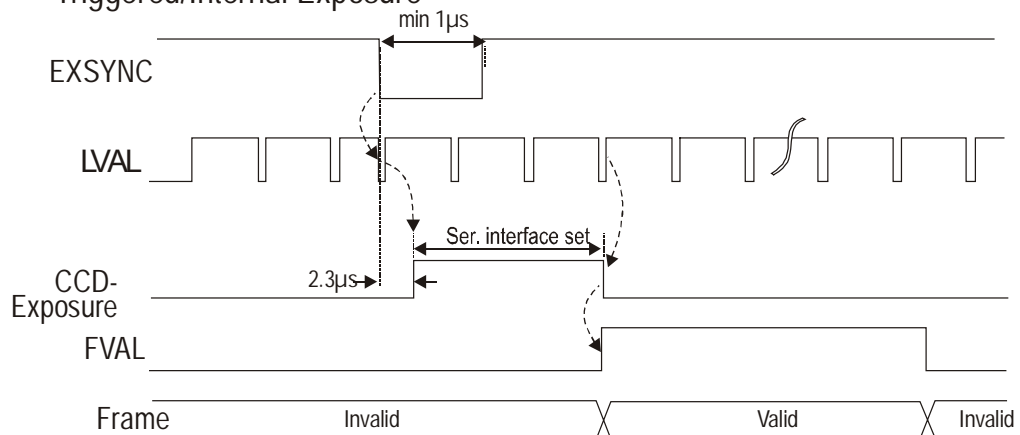
■ Pixel Timing



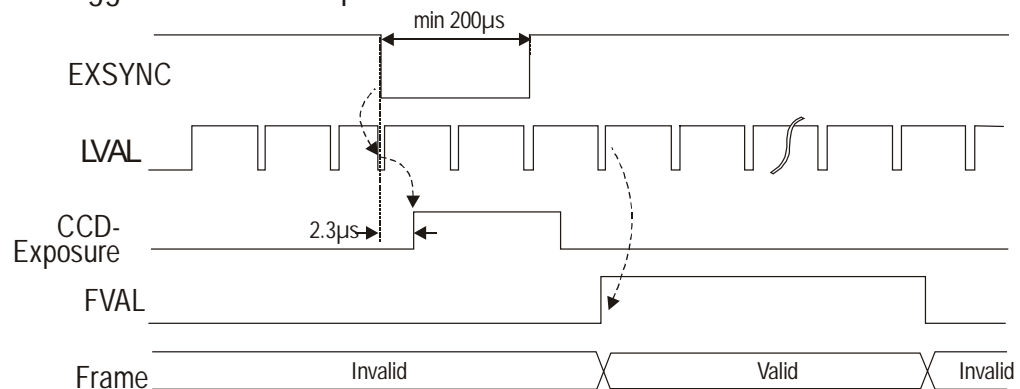
■ Line Timing

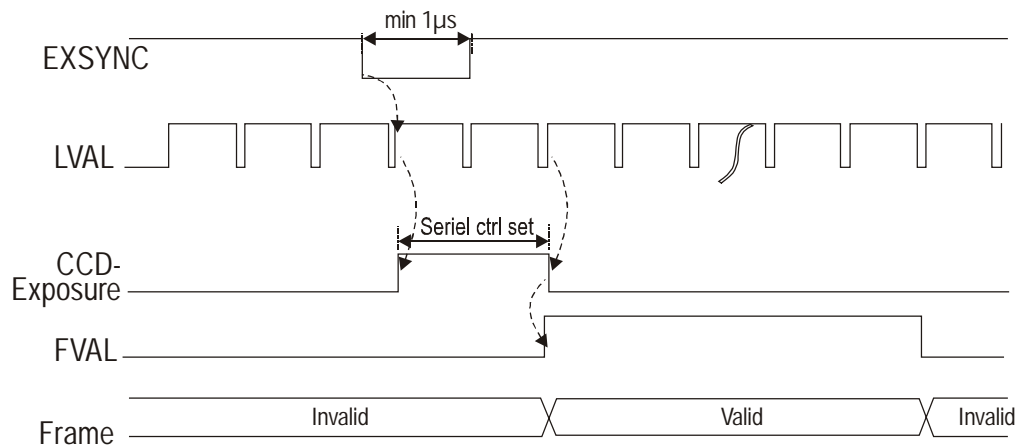
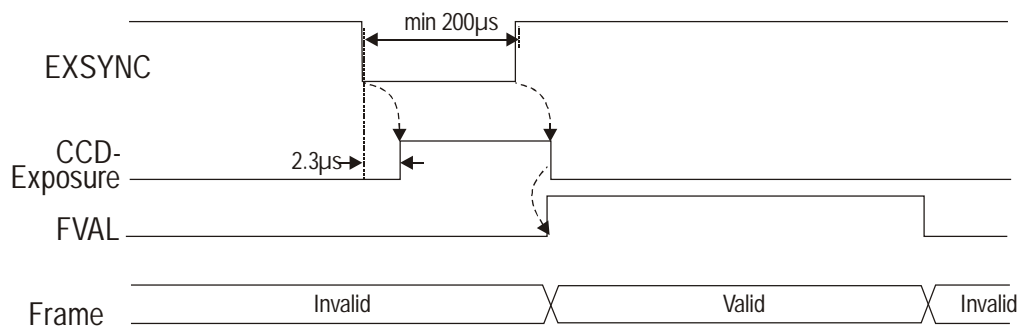


■ Triggered/Internal Exposure



■ Triggered/External Exposure



■ Internal Exposuretime set by serial control**■ External Exposuretime set by Pulswidth of EXSYNC**

**Note that above is showing SVS4021
SVS424, 204 and 285 have active high timing instead of active low.**

Appendix C : Code Description for serial Camera Control

This description is useful for those who need to integrate the camera control into an application and who cannot make use of the **Convenient Cam** program.

1. Hardware

All commands to configure the camera are made using the serial Camera Link interface.

2. Protocol

Baudrate: 9600,

8 Databit, 1 Stopbit, no parity, no Handshake

When camera is powered on the following message will be displayed.:

„KAI 4021” (or other sensor resp.) <0x0d,0x0a>“

3. Commands

The ENTER command can be activated either by “0x0d,0x0a “ or by single “ 0x0a “.

Valid tap numbers (Channelnumbers) are 1 or 2 .

If correct the camera will respond with: „OK<0x0d,0x0a>“.

If not correct it will respond „Error<0x0d,0x0a>“ .

All numbers must be typed as hexadecimal values (hexvalues)

The command strings are case sensitive.

4.1 Accessable commands for the end user :

“C<ENTER>“ : Output of camera status e.g.

KAI4020	; Sensor Type
Gain1 : 00AE	; gain tap 1
Gain2 : 00A9	; gain tap 2
Offset1 : 000A	; offset value tap1
Offset2 : 0008	; offset value tap2
CamMode : 0000	; operation mode
Expocounter: 0400	; exposure time
ControlReg2: 0002	; ADC configuration, not changeable by user
ControlReg1: 0184	; ADC configuration, not changeable by user
BlackCount : 000A	; ADC configuration, not changeable by user
CDSDelayReg: 0036	; ADC configuration, not changeable by user
ADCDelayReg: 0000	; ADC configuration, not changeable by user
SubstratV : 0038	; Substrat voltage, not changeable by user
DumpCount : 0000	; dump count for partial scan
Frames/s : 0010	; Framerate
Lines/s : 804E	; Linerate
OK	

"I<ENTER>" : out put of factory (default) data (like ser. # of product)

```
KAI4021
Serial no. : 0527
Hardware version 1.0
Firmware version 1.0
Software version 1.0
Gain1      : 007C          ; factory setting gain tap 1( = gain factor 1.0)
Gain2      : 0077          ; factory setting gain tap 2 (= gain factor 1.0)
Offset1    : 0008          ; factory setting offset tap 1
Offset2    : 0008          ; factory setting offset tap 2
OK
```

"O<Channelnr.>,<Hexvalue><ENTER>" :
Input of dark offset for the appropriate output tap
0.3FF

"G<Chanelnr.>,<Hexvalue><ENTER>" :
Input of gain for the appropriate output tap
0..2FF, gain = n * 0.045dB

"T<Hexvalue><ENTER>" :
Input of exposure time in line times.
0..FFFF in triggered mode
0..815 in freerunning mode, exposure time in line times is
816(=line count of one frame) - n

"D<Hexvalue><ENTER>" :
Input of amount of lines which are dumped out (partial scan mode).
0, 2..14A
0 = no partial scan
1 = not allowed

Formula for SVS4021xFCP and SVS4021xUCP:
2 = 2 * 19(decimal) lines dumped out
n = n * 19(decimal) lines dumped out

valid lines = 2069 - (n * 19)
n = (2069 - valid lines) / 19
(formula with decimal values)

Formula for SVS4021xSCP and SVS4021xHCP:
2 => 2 * 35(decimal) lines dumped out
n => n * 35(decimal) lines dumped out

valid lines = 2068 - (n * 35)
n = (2068 - valid lines) / 35
(formula with decimal values)

Formula for SVS11000xFCP and SVS11000xUCP:

2 => 2 * 15(decimal) lines dumped out

n => n * 15(decimal) lines dumped out

valid lines = 2704 - (n * 15)

n = (2704 - valid lines) / 15

Formula for SVS2020xFCP and SVS2020xUCP:

2 => 2 * 15(decimal) lines dumped out

n => n * 15(decimal) lines dumped out

valid lines = 1210 - (n * 15)

n = (1210 - valid lines) / 15

Formula for SVS2020xSCP and SVS11000xHCP:

2 => 2 * 27(decimal) lines dumped out

n => n * 27(decimal) lines dumped out

valid lines = 1211 - (n * 27)

n = (1211 - valid lines) / 27

Formula for SVS424/204/285xxxx:

Input of amount of valid lines

Use only even values!

0 => not allowed

2 => 2 * 8(decimal) valid lines

n => n * 8(decimal) valid lines

valid lines = n * 8

“S<ENTER>“:

saves actual configuration to EEPROM.

“R<ENTER>“: camera reset, output of status message.

“M<Hexvalue><ENTER>“:

Input of operation mode

“S<ENTER>“:

saves actual configuration to EEPROM.

“R<ENTER>“: camera reset, output of status message.

“M<Hexvalue><ENTER>“:

Input of operation mode

Following values are true:

- 0x00: free running mode , no binning
- 0x01: triggered mode, exposure time via external signal (Exsync), no binning
- 0x02: triggered mode, exposure time via Micro controller
- 0x03: reserved
- 0x04: freerunning mode, horizontal binning only;
- 0x05: triggered Mode, exposure time via external Exsync, horizontal binning only
- 0x06: triggered mode , exposure time via Micro controller, horizontal binning only

- 0x07: reserved
- 0x08: free running mode, vertical binning only for 2 lines;
- 0x09: triggered mode, exposure time via external Exsync, vertical binning only for 2 lines
- 0x0A: triggered mode, exposure time via Microcontroller , vertical binning only for 2 lines
- 0x0B: reserved
- 0x0C: free running mode, horizontal and vertical binning for 2 lines;
- 0x0D: triggered mode , exposure time via external Exsync horizontal and vertical binning for 2 lines
- 0x0E: triggered mode, exposure time via Micro controller, horizontale and vertical binning for 2 lines
- 0x0F: reserved
- 0x10-0x17 : DO NOT USE !
- 0x18: free running mode, vertical binning only for 4 lines
- 0x19: triggered mode, exposure time via external Exsync, vertical binning only for 4 lines
- 0x1A: triggered mode, exposure time via Micro controller, vertical binning only for 4 lines
- 0x1B: reserved

- 0x1C: free running mode, horizontal and vertical binning (2x4);
- 0x1D: triggered mode, exposure time via external Exsync horizontal and vertical binning(2x4)
- 0x1E: triggered mode, exposure time via Micro controller, horizontal and vertical binning(2x4)
- 0x1F: reserved

It is further possible to configure Exsync by using Bit 5 . Result is a change from the differential trigger to the TTL input trigger.

Overview over mode bits

Bit	7	6	5	4	3	2	1	0
=1	Slow Mode	Reserved always 0	Exsync via TTL-input	Reserved always 0	2 x 2 binning,	2x2 binning	triggered mode, exposure time via Micro controller	triggered mode exposure time via Exsync pulsewidth

Appendix D

Note on Camera Link Software DLL:

Serial (RS232) Interface to CAMERA LINK Frame grabbers using Camera Link DLL:

If Interface is made according to Camera Link standard:

The software does not communicate via RS 232 port of the PC but via clser*.dll-Interface.

CameraLink standard 1.0:

This is the Interface defined by "Camera Link" specification and the frame grabber manufacturer should offer/use a clser*.dll to communicate with.(The star "*" indicates the specific code of the FG manufacturer).

Camera Link standard 2.0:

In Camera Link standard version 2.0 is a DLL called clallserial.dll which allows automatically to load the correct framegrabber specific DLLs. If frame grabber does not support version 2.0 than delete clallserial.dll and use version 1.0.

OPERATION:

- After starting ConvCam simply click "OK" on error message. This is due to not cleared "communication path" of the RS232 and it must be initiated.
- for Camera Link standard 1.0 only:
 - Click on "Configuration".
 - Open "CamlinkDLL" (File browser will open)
 - Choose sub directory where clser*.dll is located. For example: For EURESYS (usually C:\WINNT\system32\), "clseremc.dll" .
- Set COM-Port to the appropriate number ("1 " for the first Camera Link connector , "2" for the second connector a.s.o.).
- Click on ReadStatus.

If there is still a problem contact us.

Appendix E

Safety Instructions

- This section contains important information for the operator (user) and/or people around him/her to avoid personal injuries, or property damages against him/her or people around him/her by using this product correctly.
- Prior to use, read this section carefully to fully understand its instructions for correct use.





Definition of markings

The meaning of each mark used in this instruction manual is given below




DANGER	This mark warns the user that improper use, indicated with this mark, may cause death or severe personal injuries against the user or people around him/her.
CAUTION	This mark warns the user that improper use, indicated with this mark, may cause personal injuries (*1) or material damages (*2) against the user or people around him/her.





Notes

- *1: Personal injuries mean wounds, burns, electric shocks, and others for which the person injured need neither to be hospitalized nor to be cared for the long term.
- *2: Material damages mean any direct or consequential damages related to property or material loss.







	This mark indicates what the user SHOULD NOT DO. The details of things, which the user should not do, are described next to this mark.
	This mark indicates what the user MUST DO. The details of things, which the user must do, are described next to this mark.
	This mark indicates that the user must be alert against a possible DANGER. The details of the DANGER, which the user must be aware of are described next to this mark.
	This mark indicates that the user is given a CAUTION against possible hazards. The details of the CAUTION, which the user must be aware of, are described next to this mark.



● Handling Precautions



 DANGER	
	<p><u>If any overheating sign is observed, discontinue the use immediately.</u></p> <p>In the event that smoke, smell, or any other overheating sign is observed, turn the power switch of the system OFF immediately and remove the power cable(s) from the system connectors, like computer, camera, lightning. Do NOT try to continue to use the system. To do so in spite of clear signs of malfunction invites a fire, an electric shock hazard, or a serious damage to the system components. In such case, contact for repair service us or our dealer/distributor, from which you purchased the system.</p>
	<p><u>If any malfunctioning sign is observed, discontinue the use immediately.</u></p> <p>Do NOT try to use the system when it is malfunctioning. (Ex. No images on the monitor) In the event of malfunction, turn the power switch of the system OFF immediately and remove the system power cables from the system components connectors. In such case, contact for repair service us or our dealer/distributor from which you purchased the system.</p>

	<p><u>If any foreign object gets into the system components, discontinue the use immediately.</u></p> <p>In the event that liquids, small particles, or any other foreign objects get into the system components, do NOT try to continue to use the system. To do so invites a fire or an electric shock hazard. In that case, turn the power switch of the system components OFF immediately and remove the system power cables from the system components connectors. After that, contact us or our dealer/distributor from which you purchased the camera for repair service/technical advice.</p>
	<p><u>Do NOT disassemble the system components.</u></p> <p>Do NOT attempt to pull apart; repair, or modify the system components on your own. To do so leads to a fire or an electric shock accident. Contact us or the dealer/distributor from which you purchased the camera for repair/modifacation.</p>
	<p><u>Do NOT supply any power than specified.</u></p> <p>The system components are designed to work only under specified voltage. Do NOT attempt to drive the system components with the power other than specified. Operating the system components under power other than specified invites a fire or a electric shock hazard.</p>
	<p><u>Do NOT use the system components in a high-humidity environment.</u></p> <p>Do NOT place the system components near a humidifier, or in other high-humidity environment. To do so may cause a fire or an electric shock accident.</p>

CAUTION

	<p>If the system components are operated in the electromagnetic field, there may be cases where noises (vertical, horizontal, or oblique stripes) may appear to a video output or causes other malfunctions. In that case, take preventive measures on the electromagnetic-wave generating source so that the system components do not receive the interference by the electromagnetic- wave. Take extra precautions against electromagnetic-wave-interference if the system components are used with a servomotor, inverter, or other electromagnetic-wave- generating equipment.</p>
	<p>Avoid giving a strong shock against the system components. If your system components are used in the system where the connector are subjected to strong repetitive shocks, the connector are possible to break down. If you intend to use your system components in such a situation, make sure to use an optional-connector-fixing-hardware to connect the connector-plug to the system components body.</p>
	<p>When the system components are not in use, put a lens or a lens-cap onto the cam head so that the image pickup plane of CCD is protected from dust, foreign object, or other flaw-causing object. If the glass plane (image pickup plane) gets dirty, clean it with a cotton swab. When it needs to be cleaned with a cleaner, be sure NOT to use any organic solvent other than ethyl alcohol. Do not clean the other system components. In such a case call us or the dealer/distributor from which you purchased the system components for cleaning or cleaning instructions.</p> <p>As a countermeasure against condensation, when the system components are moved from a warm place to a cold place, take appropriate precautions to prevent condensation from forming on the system components.</p>
	<p>Do not pull strongly the any cable nor swing it. The stress from pulling or swinging may cause damage in the coating of the cable, or breaks in the inside wires.</p>
	<p>Avoid short-circuiting its signal output. Otherwise, the system components might be damaged.</p>
	<p>If too much amount of light, (= the incoming light amount of 100 times or greater in comparison with standard light) enters CCD image pickup plane, video output might not be obtained. In such a case, take measures to reduce the amount of incoming light.</p>

	Do NOT expose the camera to intensive light (sunlight, etc.) to prevent its inner CCD from getting damaged.
	When mounting a lens, take extra caution so that the lens is not tilted, nor does flaw exist at the lens-mount-screw part. Also check to confirm that neither dirt nor other foreign object is put inside. Improper mounting might cause the parts to become locked.

 DANGER	
	Do NOT use any optional unit other than manufacturer-supplied one. We disclaim any responsibility for damages or losses incurred by user due to the use of unauthorized / unofficial option units supplied by a third party

RESTRICTION FOR USE

In case malfunction of this equipment (e.g. video output cut-off) can be expected to lead to significant accident, avoid using this equipment for such system integration use.

CASES FOR INDEMINITY (LIMITED WARRANTY)

We shall be exempted from taking responsibility and held harmless for damages or losses incurred by user in the following cases. In case damages or losses are caused by fire, earthquake, or other acts of Gods, the act by third party, misuse by the user deliberately or erroneously, use under extreme operating conditions.

- In case indirect, additional, consequential damages (loss of expected interest, suspension of business activities) are incurred as results of malfunction of non-function of the equipment, we shall be exempted from assuming responsibility for such damages.
- In case damages or losses are caused by incorrect use, which is not in line with the instructions in this instruction manual.
- In case damages or losses are caused by malfunction resulting from band connection with other equipment.
- In case damages or losses are caused by repair or modification done by the user.

IMPORTANT SAFETY INSTRUCTIONS	
1.	This device is designed and guaranteed to work under the temperature range of - 10 through 45 degree C. Avoid using the equipment beyond that limits.
2.	Do NOT expose the camera's image-pickup-plane to sunlight or other intense light directly. Its inner CCD (charge-coupled device) might be damaged.
3.	Do NOT exposure all system components to sunlight or other intensive light (UV, IR).
4.	In the event that any abnormal condition is observed, turn the power switch OFF immediately. Do NOT try to continue to use the system components. To do so in spite of clear signs of malfunction invites a fire, an electric shock hazard, or any other serious damage to the system components. In such case, contact us or our dealer/distributor that you purchased the system components from for repair service.
5.	To clean the body of this equipment, make sure to turn all power switches OFF first. To remove stubborn stains, use a soft cloth soaked in diluted acid free detergent. After that, clean with a dry cloth.
6.	In case the image-pickup-plane should be settled with fine dust, dirt, or scratched, ask our distributor for technical advice